THE FERTILIZATION OF CERTAIN FLOWERS THROUGH INSECT AGENCY.

BY THOMAS G. GENTRY.

In the spring of 1873, a few seeds of *Cucurbita ovifera* were sown in a box which had been previously filled with rich earth from the woods. In course of time they germinated, producing thrifty plants. After the latter had attained suitable heights for removal, some were transferred to the garden, and the remainder were given to friends in the vicinity; a few of the latter found their way to a thickly-built up portion of Philadelphia, and trained to grace the walls of an outhouse. All the plants flourished and fruited abundantly. The city fruit was the exact similitude of the original, globular in configuration, with a small curved neck, and of a light yellow color with a circular patch of green upon the basal part. The country plants produced more than a dozen gourds to the vine, which differed very materially from the original in size, form, and color. With one exception they were globular in shape, attaining in some instances a circumference of nearly three feet, and of a deep rich gamboge color. The exceptional case was perceptibly flattened at the ends, and marked with alternate longitudinal broad bands of deep and light shades of green, affording a striking contrast in color to the others. There was particularly noticeable in the fruit, a very close resemblance in outline and color to the ordinary pumpkin, *C. pepo*, and, indeed, the flavor and thickness of the flesh were so pumpkin-like, as to convince one unfamiliar with the facts, that it was truly the case. Whence the difference between the city fruit and that matured in the country? I think it must be attributed to the agency of insects. Many of the Bombi, for instance, *Bombus pensylvanica*, together with the little honey bee, *Apis mellifica*, were observed on scores of occasions by the writer, to visit the female flowers of *C. ovifera*, doubtless, through mistake, fancying them to be the pollen-bearing ones, with their posterior *trophi* laden with yellow pollen-grains gathered from *C. pepo*. In alighting upon a flower, a Bombus could not avoid brushing its posterior limbs against the bilobed stigmas thereof.

Here, it is evident, is a case of hybridism brought about through

the agency of bees, whereby a cross between two closely-allied species has been effected in an eminently successful manner, if the size, quality, and profusion of the fruit are any criteria. In the city specimens, fertilization has undoubtedly been accomplished through wind-agency. It is extremely doubtful that bees could have taken any part therein, since it is a rare occurrence to meet with them in a compactly built city; their presence being rarely ever observed except where conveniences for nest-building and abundance of food are met with.

Bees were also noticed by the writer to visit the female flowers of *C. ovifera*, after having previously collected pollen from the male flowers of the same vine. From this and the preceding fact, it would seem that the pollen of a very near ally has sometimes a prepotent influence over the plant's own pollen.

In Gray's Manual it is affirmed that *C. ovifera* is probably the parent of *C. pepo*. That there is a close relationship subsisting between them amounts to a settled conviction in my mind. The perfect freedom with which *C. ovifera* receives the pollen of *C. pepo*, in preference to its own, is what I should expect, if the latter has been evolved from the former, which I presume to be the case.

Supported by a trellis in front of my door, there is growing a beautiful and thrifty vine of *Wistaria Sinensis*. When the season is favorable, it is an early bloomer, throwing out its lovely purple, pendent racemes, days in advance of its long, graceful compound leaves. Its flowers usually appear with the various species of Bombi, Xylocopa and Apis, and are sources of attraction to them when other and richer sweets are absent. During the last spring my attention was attracted to these flowers, by the incessant hum which always saluted my ears when returned from my day's labors.

From morning until night, as long as the flowers remained, these busy creatures were engaged. There were *B. pensylvanica*, *B. virginicus* Fab. (queens); *Xylocopa virginica* (female) and *Apis mellifica* (worker). After watching them on many occasions for more than an hour at a time, I was surprised to discover how few entered the flowers in front for the honey which they secrete. They almost invariably perforated the vexillum. Having witnessed this operation many times, I set to work finally, to examine each individual flower of many clusters. The result of my labor showed that nearly every flower had been thus perforated. Judging from the sizes of the apertures, they were evidently the work of the

Bombi and Xylocopa; the proboscis of the honey-bee being too small and narrow to produce such results. Although hundreds of honey-bees were flying from flower to flower, not a solitary individual was noticed to enter the throats of the same. Like their larger and distant relatives, they took the shorter road. As a general rule, the little Apis enters in front. In this instance I can only attribute its deviation from custom to the power of imitation. Perceiving that the coveted material was to be had, at a great saving of labor and time, as evidenced by the examples of Bombus and Xylocopa, it had learned to profit thereby.

Although the purpose for which nature had created the flowers of Wistaria seemed to be defeated, viz., the propagation of its kind and the continuance of the species, as made manifest through previous observations, yet I did not cease to give them attention when opportunities offered. After long and weary watching for nearly one whole afternoon, I was repaid for my patience and watchfulness, by witnessing an individual of *Bombus pensylvanica* enter a flower. After this I had the gratification of witnessing similar operations performed by several others.

In order that the process may be understood, it is necessary to give a detailed description of the structure of a normal flower. In *papilionaceous* flowers, the corolla is perigynous; of five irregular petals (rarely fewer). The upper or odd petal, called the *vexillum*, is larger than the others, enclosing them in the bud, and when open is usually turned backward or spreading. The two lateral ones are called the *wings* and are situated obliquely and externally to the two lower petals; the last are connivent and more or less coherent by their anterior margins, forming a body named the *carina* or keel which usually encloses the stamens and pistil. The stamens are ten in number, diadelphous; nine in one set, in a tube which is cleft on the upper side, that is, the side next to the *standard*, and the tenth or upper one separate.

From the position of the stamens and pistils in a normal flower, the former being curved forward and overhanging the latter, it would seem that the object to be attained is the fertilization of the flower by its own pollen. But a knowledge of the degree of perfection to which the sexual parts have attained, after the release of the wings and carina from the enveloping vexillum, dissipates any such opinion. The anthers have not acquired their full development, while the stigma is perfect, judging from the viscid secre-

tion which covers its surface. By the time the anthers mature, the stigma has begun to wither. As the lower flowers of a cluster come to perfection before the upper ones, or rather as flowers may be found on the same raceme in various stages of development, it is possible to meet with some that mature their pistils at the same time that others do their stamens. It is obvious from the above that self-fertilization is out of the question. In confirmation thereof, I might cite the important fact that on a vine that produced no less than one hundred clusters, each bearing at least fifty flowers, but eight legumes were counted; seldom more than one was found on the same flower stalk; in one case I observed two.

When a Bombus visits a flower, it alights upon the *vexillum*, and in order to get to the honey, thrusts its proboscis downward between the *keel* and *standard* which are in close contact. The effort thus expended forces the carina backward which releases the second set of stamens and the pistil (the first being already free) from their confinement. The pollen-grains being already ripe, become dislodged from their box-shaped anthers, and fall down upon the head and back of the bee. The bee passes to another flower, further up on the same stem. The same process is effected, which permanently releases the stamens and pistils (the former being undeveloped). In the act of retiring, the head and sometimes the back come into contact with the stigmatic surface of the pistil which projects slightly beyond the stamens, and which being abruptly curved downward, cannot escape fertilization.

At the time of writing, June 29, 1874, a second crop of flowers is visible. These are principally secondary clusters, which have pushed from the long, pendent compound leaves, which are to be observed at the basal third of the primary floral axes. For more than a week I have attentively watched these flowers, in the hope of witnessing the visits of bees. Up to the present moment it has not been my privilege. Bombi pass and repass without being attracted. Within the woodwork of the trellis which supports the vine, are several burrows of *Xylocopa virginica*, and within a few inches of the aperture which forms the mode of ingress and egress, there is hanging a cluster of flowers, whose conspicuous color of purple and strong fragrance could not fail to invite attention and induce acceptance, were there a disposition upon the part of this insect.

When the clovers, particularly *Trifolium prætense*, are in blos-

som, and the delicious sweets which they yield are eagerly sought after, all other luxuries are held at a discount. Bees appear to be very fastidious, so to speak, in their tastes; seldom noticing plants of inferior qualities, except as necessity demands.

July 14th. The flowers have all fallen and not a legume, nor the trace of one, from this second flowering is to be seen. During repeated examinations of these secondary clusters, there was observed nothing in the structure of the stamens and pistil of any flower, to prevent self-fertilization, provided they had come to maturity at the same time. There was abundance of pollen in the anthers, and the stigmatic surface of the pistils was open and coated with a viscid secretion. The presence of bees and the development of fruit in a few instances where aided by those insects, associated with the opposite condition, to wit, the absence of bees and the consequent absence of fruit, the flowers being ready but the bees being unwilling, are incontrovertible evidence of the fact that bees are essential to the fertilization of *Wistaria Sinensis*.

BOTANICAL OBSERVATIONS IN SOUTHERN UTAH.

BY DR. C. C. PARRY.

No. 4.

THE following list comprises the collection of plants made in the above district, in the season of 1874.

The numbers given correspond to those affixed to the distributed sets, and referred to in the previous papers. Where no numbers are given the plants named were either scantily collected, or merely observed. In a few instances the unnumbered plants, though belonging to this locality, were derived from other sources as indicated in the text. Where no special locality is given, the valley of the Virgen in the vicinity of St. George is to be inferred. To the notes and descriptions following any particular species furnished by other collaborators, the name of the author is appended.

No. 1. *Anemone decapetala* L. Rocky ledges. April.

No. 2. *Ranunculus Andersonii* Gray, Var., *tenellus* Watson. King's Rep. p. 7, t. 1.